Theory of Differential Calculus

Learning Targets and Checkpoints

Fall 2021 **Subhadip Chowdhury** **Math 115**

The purpose of this document is to give details on how Checkpoints are used to attain fluency on Learning Targets, what Checkpoint problems cover, how they are graded, what resources are approved for use on Checkpoints and how to use them, and when Checkpoints will take place. **Complete transparency** is the goal; if you have questions or if there's something that needs to be added to this document, please let me know.

§A. Learning Targets

The star (★) marked LTs are counted as Core LTs.

- **L1★:** I can define and evaluate (using algebra) the limit of a function as the input approaches a point (possibly from just one side) or at infinity.
- **L2★:** I can define and determine the continuity of a function at a point or in general, and correctly characterize types of discontinuities.
- **L3:** I can state and use the Intermediate Value Theorem.
- **L4★:** I can write down the correct limit expression that would compute the derivative of a function at a point or in general; and determine differentiability of the function using limit calculations.
- **L5★:** I can use the Product, Quotient, and Chain Rules to compute the derivative of ''advanced'' functions (meaning logarithmic, exponential, and trigonometric functions along with simpler functions that are combined with these); and apply them in general for any function.

  Note: On this Learning Target, you will be asked to list the rules you use in the correct order in which they are used.
- **L6:** I can correctly apply the rules for differentiating the inverse of a function and evaluate derivatives involving inverse trigonometric functions.
- **L7:** I can state the Mean Value Theorem and apply it to solve various Calculus problems.
- **L8:** I can correctly explain and apply L'Hopital's rule to evaluate limits and compare growth of functions.
- **L9:** I can differentiate functions implicitly and find equation of tangent lines to a curve.
- **L10★:** I can relate the rates of change of variables in an applied problem.
- **L11★:** Given information about the derivative of a function, I can sketch its graph highlighting its monotonicity, convexity, roots, asymptotes etc.
- **L12★:** Given a geometric or applied optimization problem, I can set it up as a Calculus problem, find the point where the target quantity is optimized, and give a mathematical explanation for why the quantity is optimized there.

§B. Learning Targets by Checkpoints

These dates are tentative and may get updated in the future.

Checkpoint	Learning Targets	Date assigned	Date due
1	L1, L2	Oct 29 (Friday)	Nov 1 (Monday)
2	L1, L2, L3, L4, L5	Nov 5 (Friday)	Nov 9 (Tuesday)
3	L1, L2, L3, L4, L5, L6, L7	Nov 12 (Friday)	Nov 16 (Tuesday)
4	L3, L4, L5, L6, L7, L8, L9	Nov 19 (Friday)	Nov 23 (Tuesday)
5	L6, L7, L8, L9, L10, L11	Dec 3 (Friday)	Dec 7 (Tuesday)
6	L8, L9, L10, L11, L12	Dec 10 (Friday)	Dec 13 (Monday)
7	L10, L11, L12	Dec 15 (Wednesday)	Dec 17 (Friday)

§C. Overall Grading Criteria for Checkpoints

There are some common criteria for a solution to be considered **"satisfactory"**:

- **There can be no instances of significant errors.** A "significant" error is one that is *directly related to the Learning Target itself and causes the solution to fail to provide conclusive evidence of fluency*. Examples include (but are not limited to) the following:
  - *A significant computational error* that shows more work needs to be done to get fluency on the computation (for example: getting the subtraction reversed in the Quotient Rule; or computing the derivative of $\cos(x)$ as $+\sin(x)$ instead of $-\sin(x)$).
  - *A significant conceptual error* that demonstrates the need to understand the concept further (for example: writing the limit dewfinition of derivative wrong; interpreting a positive first derivative as concave up; etc.).
  - *An unclear explanation* that demonstrates the need to understand the concept further.
  - *Significant omissions* including not doing a part of a multi-part problem (even if by accident); or leaving out an essential part of a solution, for example not finding the value of the constant for an initial value problem.
  - *A highly disorganized presentation of a solution* - That is, the solution is so messy and incoherent that it is not easy for the reader to determine if the student has understood the concept.
  - *A copy error that oversimplifies the problem* - For example, copying down $f(x) = e^{x^2}$ on a question as $f(x) = x^2$ or $f(x) = e^x$.
- **There can be no more than a single instance of a "simple" error.** A "simple" error is an error that is *not directly related to the Learning Target itself and doesn't get in the way of seeing that the student is fluent with the concept.* Examples of simple errors include:
  - Errors in arithmetic or algebra that are not central to the Learning Target and do not oversimplify the problem. For example, working through a derivative and everything is correct except a minus sign was dropped in the final answer.

- ▹ Copy errors that do not oversimplify the problem. For example, if your mistake makes the problem roughly the same level of difficulty as the correct version, I will read your solution to make sure the answer and process are correct.

Generally speaking, **you are not being graded on your answers but on your explanations, processes, and reasoning.** While correct answers are expected and required (except for simple errors), the evidence of your fluency on the Learning Targets does not come from the answers; it comes from your work that leads to the answer. So **make every effort not only to provide right answers but also full, correct, clearly expressed explanations** that back up your answers. *Remember you are doing work here to convince the reader that you are fluent with the ideas*. Like in a courtroom, provide ample evidence, clearly expressed, that you have done so.

Finally please note that:

- *Two simple errors in the same problem, no matter what the type, results in unacceptable work.* It is acceptable to make a simple error once, but not twice.
- To avoid all forms of error, use the approved tools listed below to double-check all your work before submitting it. **For example, you are allowed to use `WolframAlpha` to double check the answers for derivative calculations; you just need to supply a complete and clear solution. In this way, your work should never really contain errors unless they are significant conceptual misunderstandings.**

§D. Approved resources for Checkpoints

You are approved to use the following resources on all Checkpoints:

- The class notes, textbooks and any external site that is linked inside the class notes.
- Any video or document posted to the class Moodle site.
- The websites WolframAlpha and Desmos.

Any resource not included on above list is to be considered off-limits and not approved for use on Checkpoints. Evidence of using unapproved resources will be considered academic dishonesty. Resources that are NOT allowed include:

- Solution websites such as Chegg
- Other students in the class, or past students from other Math classes
- Other textbooks or videos not included above

Please see the **Collaboration and Academic Honesty** policy in the `Assessment` document for more information. If there is a resource that is not on the approved list that you'd like to use, please ask me (Prof. Chowdhury) for permission. Additional resources may be added to this list later.